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EO/US
PCT/EP98/06985

PATENT COOPERATION TREATY

From the INTERNATIONAL BUREAU

PCT

NOTIFICATION OF ELECTION

(PCT Rule 61.2)

To:

United States Patent and Trademark Office
(Box PCT)
Crystal Plaza 2
Washington, DC 20231
ÉTATS-UNIS D'AMÉRIQUE

in its capacity as elected Office

Date of mailing: 06 May 1999 (06.05.99)	
International application No.: PCT/EP98/06985	Applicant's or agent's file reference: CE30382P/PCT
International filing date: 21 October 1998 (21.10.98)	Priority date: 27 October 1997 (27.10.97)
Applicant: JEPSEN, Rene et al	

1. The designated Office is hereby notified of its election made:

[X] in the demand filed with the International preliminary Examining Authority on:

22 March 1999 (22.03.99)

[ ] in a notice effecting later election filed with the International Bureau on:

2. The election [X] was

[ ] was not

made before the expiration of 19 months from the priority date or, where Rule 32 applies, within the time limit under Rule 32.2(b).

The International Bureau of WIPO **34, chemin des Colombettes** **1211 Geneva 20, Switzerland**	Authorized officer: J. Zahra
Facsimile No.: (41-22) 740.14.35	Telephone No.: (41-22) 338.83.38

Form PCT/IB/331 (July 1992)

2592281

PATENT COOPERATION TREATY

PCT

INTERNATIONAL SEARCH REPORT

(PCT Article 18 and Rules 43 and 44)

Applicant's or agent's file reference	**FOR FURTHER ACTION**	see Notification of Transmittal of International Search Report (Form PCT/ISA/220) as well as, where applicable, item 5 below.
CE30382P/PCT		
International application No.	International filing date *(day/month/year)*	(Earliest) Priority Date *(day/month/year)*
PCT/EP 98/ 06985	21/10/1998	27/10/1997
Applicant		
MOTOROLA LIMITED et al.		

This International Search Report has been prepared by this International Searching Authority and is transmitted to the applicant according to Article 18. A copy is being transmitted to the International Bureau.

This International Search Report consists of a total of 3 sheets.

[X] It is also accompanied by a copy of each prior art document cited in this report.

1. [ ] **Certain claims were found unsearchable** (see Box I).

2. [ ] **Unity of invention is lacking** (see Box II).

3. [ ] The international application contains disclosure of a **nucleotide and/or amino acid sequence listing** and the international search was carried out on the basis of the sequence listing
   - [ ] filed with the international application.
   - [ ] furnished by the applicant separately from the international application,
     - [ ] but not accompanied by a statement to the effect that it did not include matter going beyond the disclosure in the international application as filed.
   - [ ] Transcribed by this Authority

4. With regard to the **title,**
   - [ ] the text is approved as submitted by the applicant
   - [X] the text has been established by this Authority to read as follows:

   MULTIMODE COMMUNICATION SYSTEM AND METHOD FOR COMMUNICATION

5. With regard to the **abstract,**
   - [X] the text is approved as submitted by the applicant
   - [ ] the text has been established, according to Rule 38.2(b), by this Authority as it appears in Box III. The applicant may, within one month from the date of mailing of this International Search Report, submit comments to this Authority.

6. The figure of the **drawings** to be published with the abstract is:

   Figure No. 4
   - [ ] as suggested by the applicant.
   - [X] because the applicant failed to suggest a figure.
   - [ ] because this figure better characterizes the invention.
   - [ ] None of the figures.

INTERNATIONAL SEARCH REPORT

International Application No
PCT/EP 98/06985

A. CLASSIFICATION OF SUBJECT MATTER
IPC 6 H04Q7/30 H04B7/26

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 6 H04Q H04B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	EP 0 662 775 A (ERICSSON GE MOBILE INC) 12 July 1995 see column 1, line 57 - column 2, line 2 see column 7, line 44 - line 46 see column 8, line 30 - line 39 see column 9, line 10 - line 23 ---	1,4,11
X	US 5 566 168 A (DENT PAUL W) 15 October 1996 see column 7, line 33 - line 42 ---	1,4,11
X	WO 95 24086 A (THIELECKE JORN ;GRANZOW WOLFGANG (DE); PHILIPS PATENTVERWALTUNG (D) 8 September 1995 see page 6, line 8 - line 10 --- -/--	1,5,11

[X] Further documents are listed in the continuation of box C.

[X] Patent family members are listed in annex.

° Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
24 February 1999	03/03/1999

Name and mailing address of the ISA	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax: (+31-70) 340-3016	Leouffre, M

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Form PCT/ISA/210 (second sheet) (July 1992)

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication,where appropriate, of the relevant passages	Relevant to claim No.
E	WO 98 51111 A (KONINKL PHILIPS ELECTRONICS NV ;PHILIPS AB (SE)) 12 November 1998 see abstract; claims 4,5 ---	1,4,11
A	EP 0 600 713 A (NOKIA MOBILE PHONES LTD ;NOKIA TELECOMMUNICATIONS OY (FI)) 8 June 1994 see column 6, line 32 - line 42; figure 4A -----	1,4,11

1

INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No
PCT/EP 98/06985

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
EP 0662775 ✓ A	12-07-1995	US 5539730 A	23-07-1996
		AT 167774 T	15-07-1998
		AU 688851 B	19-03-1998
		AU 1565295 A	01-08-1995
		AU 5210598 A	12-03-1998
		BR 9505639 A	09-01-1996
		CA 2156739 A	13-07-1995
		CN 1124076 A	05-06-1996
		DE 69503072 D	30-07-1998
		DE 69503072 T	10-12-1998
		ES 2120157 T	16-10-1998
		FI 954208 A	08-11-1995
		JP 9500512 T	14-01-1997
		SG 52333 A	28-09-1998
		WO 9519079 A	13-07-1995
		US 5566168 A	15-10-1996
		ZA 9500169 A	05-02-1996
US 5566168 A	15-10-1996	US 5539730 A	23-07-1996
		AT 167774 T	15-07-1998
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		DE 69503072 T	10-12-1998
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		ES 2120157 T	16-10-1998
		FI 954208 A	08-11-1995
		JP 9500512 T	14-01-1997
		SG 52333 A	28-09-1998
		WO 9519079 A	13-07-1995
		ZA 9500169 A	05-02-1996
WO 9524086 ✓ A	08-09-1995	EP 0696398 A	14-02-1996
		JP 8509592 T	08-10-1996
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WO 9851111 ✓ A	12-11-1998	NONE	
EP 0600713 ✓ A	08-06-1994	FI 925472 A	02-06-1994
		AU 676856 B	27-03-1997
		AU 5210493 A	16-06-1994
		CN 1094204 A	26-10-1994
		JP 6318927 A	15-11-1994
		US 5533013 A	02-07-1996

M.H

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PATENT COOPERATION TREATY

PCT

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

(PCT Article 36 and Rule 70)

Applicant's or agent's file reference	FOR FURTHER ACTION	See Notification of Transmittal of International Preliminary Examination Report (Form PCT/IPEA/416)
CE30382P/PCT		
International application No.	International filing date *(day/month/year)*	Priority date *(day/month/year)*
PCT/EP98/06985	21/10/1998	27/10/1997
International Patent Classification (IPC) or national classification and IPC H04Q7/30		
Applicant MOTOROLA LIMITED et al.		

1. This international preliminary examination report has been prepared by this International Preliminary Examining Authority and is transmitted to the applicant according to Article 36.

2. This REPORT consists of a total of 5 sheets, including this cover sheet.

   ☐ This report is also accompanied by ANNEXES, i.e. sheets of the description, claims and/or drawings which have been amended and are the basis for this report and/or sheets containing rectifications made before this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions under the PCT).

   These annexes consist of a total of sheets.

3. This report contains indications relating to the following items:

   - I ☒ Basis of the report
   - II ☐ Priority
   - III ☐ Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
   - IV ☐ Lack of unity of invention
   - V ☒ Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations suporting such statement
   - VI ☐ Certain documents cited
   - VII ☒ Certain defects in the international application
   - VIII ☒ Certain observations on the international application

Date of submission of the demand	Date of completion of this report
22/03/1999	28.01.2000
Name and mailing address of the international preliminary examining authority: European Patent Office D-80298 Munich Tel. +49 89 2399 - 0 Tx: 523656 epmu d Fax: +49 89 2399 - 4465	Authorized officer Rabe, M Telephone No. +49 89 2399 8801

Form PCT/IPEA/409 (cover sheet) (January 1994)

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

International application No. PCT/EP98/06985

I. Basis of the report

1. This report has been drawn on the basis of (*substitute sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to the report since they do not contain amendments.*):

Description, pages:

1-10 as originally filed

Claims, No.:

1-11 as originally filed

Drawings, sheets:

1/3-3/3 as originally filed

2. The amendments have resulted in the cancellation of:

☐ the description, pages:
☐ the claims, Nos.:
☐ the drawings, sheets:

3. ☐ This report has been established as if (some of) the amendments had not been made, since they have been considered to go beyond the disclosure as filed (Rule 70.2(c)):

4. Additional observations, if necessary:

V. Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

Novelty (N)	Yes:	Claims	9-10
	No:	Claims	1,11
Inventive step (IS)	Yes:	Claims	
	No:	Claims	1-11
Industrial applicability (IA)	Yes:	Claims	1-11
	No:	Claims	

2. Citations and explanations

see separate sheet

VII. Certain defects in the international application

The following defects in the form or contents of the international application have been noted:

see separate sheet

VIII. Certain observations on the international application

The following observations on the clarity of the claims, description, and drawings or on the question whether the claims are fully supported by the description, are made:

see separate sheet

A. Citations and explanations made in respect of paragraph V:

1. The document **EP-A-0 662 775** (see in particular abstract; column 1, lines 3 to 5; column 1, line 57 to column 2, line 2; column 2, line 57 to column 3, line 19; column 9, lines 10 to 12; Figure 2) discloses, according to **all** the features of **claim 1**, a communication system including a first central station, a plurality of remote units, and a frequency spectrum for providing communication services to the plurality of remote units (see in particular column 1, lines 3 to 5; column 2, line 57 to column 3, line 9), the communication system comprising:

means for transmitting between the first central station and a first remote unit in a first portion of the frequency spectrum in a first direction using a first transmission scheme (see in particular column 1, line 57 to column 2, line 1; column 9, lines 10 to 12; see also fourth line in Figure 2: "MOBILE 3 RECEIVE"); and

means for transmitting simultaneously between the first central station and a second remote unit in a first portion of the frequency spectrum in a second direction using a second transmission scheme (see in particular column 2, lines 1 to 2; column 9, lines 10 to 12; see second line in Figure 2: "MOBILE 1 TRANSMIT").

The subject-matter of claim 1 therefore is **not new**, Article 33 (2) PCT.

It should furthermore be noted that even if novelty of claim 1 could be argued, based on minor differences between the features of claim 1 and those disclosed in EP-A-0 662 775, the subject-matter of said claim would **not involve an inventive step**, Article 33 (3) PCT, having regard to the disclosure of EP-A-0 662 775 and the normal knowledge of a person skilled in the art of radio communication systems and related shared spectrum communication technologies (see eg. the disclosure of **WO 95/24086**, in particular page 6, lines 8 to 10).

2. The same considerations as made in above paragraph 1 in respect of claim 1 are also valid for **independent claim 11** since claim 11 includes the same subject-matter as claim 1 in terms of a method claim.

The subject-matter of independent claim 11 therefore is **neither new**, Article 33 (2) PCT, **nor does it involve an inventive step**, Article 33 (3) PCT.

3. **Dependent claims 2 to 10** do **not** appear to contain any additional features which, in combination with the features of any claim to which they refer, involve an inventive step for the reason that the subject-matter of said claims **either** is **in principle** directly derivable from the disclosure of **EP-A-0 662 775** (see in particular column 1, line 40 to column 2, line 14; column 2, line 57 to column 3, line 19; column 4, line 40 to column 5, line 10; column 7, lines 44 to 46; column 9, lines 10 to 23) or **WO 95/24086** (see in particular page 6, lines 8 to 10), **or** represents minor design details which are based on the general knowledge of the person skilled in the field of radio communication systems and related shared spectrum communication technologies.

   Dependent claims 2 to 10 therefore **do not** meet the requirements of Article 33 (3) PCT.

B. Remarks made in respect of paragraph VII:

1. To meet the requirements of Rule 5.1 (a) (ii) PCT, the cited documents **EP-A-0 662 775** and **WO 95/24086**, which represent a relevant state of the art in respect of the present application, should have been identified in the opening part of the description and the relevant background art disclosed therein should have been briefly discussed.

2. To meet the requirements of Rule 6.3 (b) PCT, any independent claim should have been correctly cast in the **two-part form**, with those features which in combination are part of the nearest prior art (eg. EP-A-0 662 775) being placed in the preamble.

C. Remarks made in respect of paragraph VIII:

The feature of **claim 5**, that an OFDMA scheme is used in the first direction, is **not** referred to in the description. Claim 5 is therefore **not** supported by the description as required by Article 6 PCT.

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09/530310

PCT WORLD INTELLECTUAL PROPERTY ORGANIZATION
International Bureau

INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification 6 : H04Q 7/30, H04B 7/26

A1

(11) International Publication Number: **WO 99/22534**

(43) International Publication Date: 6 May 1999 (06.05.99)

(21) International Application Number: PCT/EP98/06985

(22) International Filing Date: 21 October 1998 (21.10.98)

(30) Priority Data:
9722511.4 27 October 1997 (27.10.97) GB

(71) Applicant *(for all designated States except US)*: MOTOROLA LIMITED [GB/GB]; Jays Close, Viables Industrial Estate, Basingstoke, Hampshire RG22 4PD (GB).

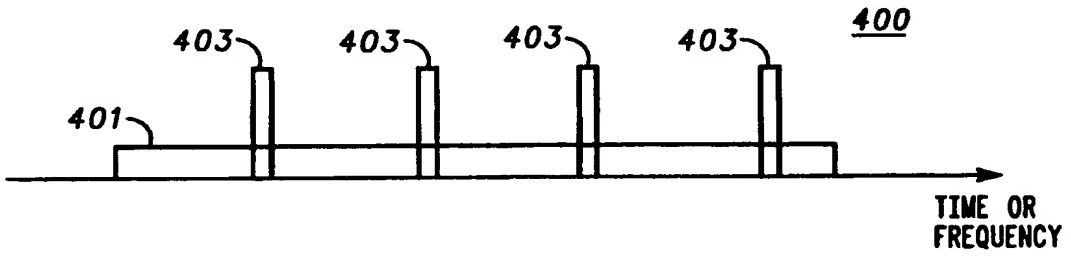
(72) Inventors; and
(75) Inventors/Applicants *(for US only)*: JEPSEN, Rene [DK/GB]; 5 Bancroft Close, Grange Park, Swindon, Wiltshire SN5 6HB (GB). O'NEILL, Rorie [GB/GB]; 25 Applewood Court, Westlea, Swindon, Wiltshire SN2 7AH (GB). KARIMI, Reza [GB/GB]; 17 Hodds Hill, Swindon, Wiltshire SN5 5BJ (GB). MOHEBBI, Behzad [GB/GB]; 12 Cambridge Park Court, Cambridge Park, Twickenham TW1 2JN (GB).

(74) Agents: IBBOTSON, Harry et al.; Motorola, Intellectual Property Operations, Midpoint, Alencon Link, Basingstoke, Hampshire RG21 7PL (GB).

(81) Designated States: CN, IL, RU, US, European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE).

Published
With international search report.
Before the expiration of the time limit for amending the claims and to be republished in the event of the receipt of amendments.

(54) Title: MULTIMODE COMMUNICATION SYSTEM AND METHOD FOR COMMUNICATION



(57) Abstract

A communication system (100) including at least one central (101) and a number of remote units (103) is provided which utilise a shared spectrum (203) for simultaneous communication in the uplink and downlink direction. According to the invention different transmission schemes are used in the two directions for reducing the cross interference between remote units (103) uplinking and remote units (103) downlinking in the shared spectrum. The different transmission schemes are characterised by one (401) having the signal energy spread in preferably both the time and frequency domain whereas the other (403) transmission scheme is characterised by having signal energy concentrated in both the frequency and time domain.

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MULTIMODE COMMUNICATION SYSTEM AND METHOD FOR COMMUNICATION

Field of the Invention

This invention relates to a communication system comprising at least one central and a number of remote units and employing a shared frequency band.

Background of the Invention

Communication systems including at least one central and a number of remote units typically use separate portions of the frequency spectrum or frequency bands for the uplink (remote units transmitting to the central station) and the downlink (the central station transmitting to the remote units). A typical example of such a system is the Global System for Mobile telecommunication (GSM) where the uplink and downlink are transmitted in different frequency bands 45 MHz apart.

A major disadvantage with separate frequency bands is the inflexibility caused by the need for a fixed allocation of total spectrum used for the uplink and for the downlink.
In many systems the total traffic distribution between the uplink and downlink vary significantly with time. A fixed allocation of spectrum for each direction therefore requires dimensioning for worst case scenarios in the up- and downlink independently whereas the total traffic may be significantly less than the sum of the individual worst case situations. A significant improvement can be obtained if the spectrum can be dynamically allocated between the uplink and downlink.

As an example it has been identified that the variation in time of the traffic distribution between the uplink and downlink in the future Universal Mobile Telecommunication System (UMTS) will be very large. As a result it has been specified that it will be advantageous if the UMTS air interface will be able to share spectrum dynamically between uplink and downlink.

Separation of different radio signals in communication systems is achieved by separation in either time, frequency, code or a combination thereof. However, when sharing the same spectrum between uplink and downlink the separation becomes increasingly difficult as the power variation between desired and undesired signals can be extremely large. A typical example is the situation where a remote unit is located on the edge of the coverage area and therefore receives a very weak signal from the central station. At the same time a nearby remote unit may transmit to the central station using high power as it is also close to the edge of the coverage area thereby causing a very strong interfering signal.

If the signals are separated in time, such as in a Time Division Duplex (TDD) scheme the interference can be constrained to time intervals not used by the current remote unit and separation can therefore be very effective. However, the requirement for guard time between transmission and reception makes a time division scheme impractical for anything beyond very small cells (typically less than one kilometre). Division in frequency requires a very large attenuation of the unwanted signal due to the high power variation between the signals and this imposes very strict requirements on the filters resulting in large and expensive filters. Similarly, division in code will also require a very large attenuation of the unwanted signal due to the high power variation and this will result in the need for very long codes which complicates the receiver design significantly.

A new invention is therefore desired for facilitating the sharing of spectrum between the uplink and downlink.

Summary of the Invention

According to the present invention, there is provided a communication system including a first central station, a plurality of remote units, and a frequency spectrum for providing communication services to the plurality of remote units, the communication system comprising: means for transmitting between the first central station and a first remote unit in a first portion of the frequency spectrum in a first direction using a first transmission scheme;

and the communication system being characterised by comprising: means for transmitting simultaneously between the first central station and a second remote unit in the first portion of the frequency spectrum in a second direction using a second transmission scheme.

The different transmission schemes are preferably characterised by one having the signal energy spread in preferably both the time and frequency domain whereas the other transmission scheme having signal energy concentrated in preferably both the frequency and time domain.

According to one feature of the invention the spread energy signals can be spread un-evenly thereby concentrating signal energy in frequencies with the minimum cross-directional interference. According to another feature of the invention, remote units may be allocated spectrum so that units uplinking and downlinking in the shared portion of the frequency spectrum are separated geographically thereby increasing the minimum coupling loss between the units and thus minimising the interference.

According to a second aspect of the invention there is provided a method for communication in a communication system including a first central station, a plurality of remote units, and a frequency spectrum for providing communication services to the plurality of remote units, the method comprising the steps of: transmitting between the first central station and a first remote unit in a first portion of the frequency spectrum in a first direction using a first transmission scheme; and the method being characterised by comprising the step of: transmitting simultaneously between the first central station and a second remote unit in the first portion of the frequency spectrum in a second direction using a second transmission scheme.

Brief Description of the Drawings

FIG. 1 is an illustration of a typical communication system to which this invention may apply.

FIG. 2 is an illustration of frequency band allocation for uplink and downlink traffic in a preferred embodiment.

FIG. 3 is an illustration of a preferred embodiment of a remote unit.

FIG. 4 is an illustration of an example of signal energies spread or concentrated according to the invention.

FIG. 5 is an illustration of an uneven spreading of signal energy applied to the spread energy signal.

FIG. 6 is an illustration of a preferred allocation of channels in the shared frequency band to remote units.

FIG. 7 is an illustration of a process flowchart of a preferred method of allocating channels to users.

Detailed Description of a Preferred Embodiment

According to the present invention, a communication system 100 allowing sharing of spectrum between the uplink and downlink is provided, the system comprising at least one central station and a plurality of remote units. FIG. 1 illustrates such a system where a central station 101 communicates with a number of remote units 103 over radio channels 105. Specifically, the communication system can be a cellular system where the central station covers users within a certain geographical area 107 whereas other geographical areas 109,111 are covered by other central stations 113,115. An example of such a system is the UMTS cellular system undergoing standardisation in the European Telecommunications Standards Institute.

According to the present invention at least a portion of the spectrum is allocated for simultaneous use in the uplink and downlink direction. A

preferred spectrum allocation 200 is shown in FIG. 2. A portion of the spectrum is allocated for uplink 201, another for downlink 205 and a third is shared between up- and downlink 203. It is preferred that call setup is performed using the separate up- and downlink portions of the frequency spectrum 201,205 as the interference in these bands are expected to be less than in the shared spectrum 203. The interference in the shared spectrum can be very severe in some situations for example if a remote unit using this band for uplink is very close to a remote unit using the same spectrum for downlink.

The principle of the current invention is to use a hybrid air interface at least in the shared portion of the frequency spectrum by employing different transmission schemes which cause the least cross-interference between the uplink and downlink. The preferred system will spread the signal energy in one direction as much as possible while concentrating the signal energy as much as possible in the other direction. The spreading of energy in one direction will preferably be in both the time and frequency domain and similarly the concentration of signal energy in the other direction will also preferably be in both the time and frequency domain.

A preferred implementation of a remote unit 103 is illustrated in FIG. 3. The remote unit 103 comprises an antenna 301 connected to a duplexer 311 which again is connected to a receiver unit 303 and transmitter unit 309. The receiver and transmitter units 303,309 are connected to a controller 305 which is connected to a user interface 307. The remote unit 103 thus provides means for transmission and reception of user data under the control of a controller 305. The transmitting unit 309 is able to transmit using a different transmission scheme than the receiving unit 303. For example according to the invention the transmitting unit 309 can employ a time continuous broadband signal whereas the receiving unit 303 can employ a time division narrow band signal. In addition the transmitter unit 309 and receiver unit 303 may be able to use a plurality of transmission schemes and operate in a plurality of different frequency bands. The central station 101 is similar to the remote units 103 but the transmission schemes available will typically be reciprocal to the remote units 103, so that the transmission schemes available to the receiving unit 303 in the remote unit 103 will be available in the transmitting unit 309 of the central station 101 and vice

versa. Which transmission scheme to use is determined in the controller 305 in the remote units 103, the central station 101 or may be distributed throughout the system. The details of receiver and transmitter design for various transmission schemes are well known in the art, and the skilled person may use any known method of transmitter or receiver design without detracting from the present invention.

A preferred energy distribution 400 is illustrated in FIG. 4 where a spread energy signal 401 and concentrated energy signals 403 are shown.

When considering the frequency domain the spread energy signal 401 corresponds to a broadband signal where the radio signal occupies a relatively high bandwidth but has relatively low spectral energy density. Preferably the signal is spread using a spread spectrum technique as is well known in the art. Other alternatives for spreading the signal include known techniques such as frequency hopping or increasing the bandwidth of the signal by introducing redundant data. An example of the latter is the use of Forward Error Correcting (FEC) codes which allows transmission at lower spectral power density and increased bandwidth. The concentrated energy signals corresponds to standard narrowband signals where no or limited frequency spreading is applied.

When considering the time domain, the spread energy signal corresponds to a signal of long duration in comparison to the transmissions of the concentrated energy signal, preferably it is a continuous signal. The concentrated energy signal corresponds to a signal which performs the transmissions in short bursts rather than continuous transmissions. These signals are for example used in TDMA communication systems. The spread energy signal is thus characterised by having a relatively low variation in transmitted power whereas the concentrated energy signal will have high peak power during transmission bursts.

When receiving the signals the high disparity between the two transmission formats will provide significant benefits in terms of reduction of the interference level, the possibility of using interference reduction receiver techniques and the possibility of using techniques minimising the impact of the given interference.

When receiving the concentrated energy signal such as a non-frequency spread TDMA signal, the interference energy from a possible nearby strong interferer will be spread in both time and frequency. The interference energy contained in the relevant time-slot and narrow frequency channel is therefore minimised. As an example, if a GSM speech call is considered a 200 kHz channel is used. Assuming an interfering signal is spread to 5 MHz (as is considered for UMTS), the interference power of this signal in the narrowband GSM channel will be reduced by 25 times i.e. by 14 dB. The reduction of interference power will substantially decrease the dynamic range requirement of the receiver. In addition the GSM TDMA signal has a duty cycle of 1/8 and the total reduction in interference energy is thus 200 times i.e. 23 dB.

When receiving the spread energy signal the concentrated energy signal can have a very high interference level but this will be concentrated preferably both in time and frequency. It is thus possible to remove this high interference by filtering using for example a notch filter. This will again remove a potentially very high interference level thereby significantly reducing the dynamic range requirements of the receiver. The filtering of the unwanted narrowband interferer will also remove a part of the wanted signal. However, as the filtering is concentrated to a narrow bandwidth and a short timeslot, this effect will be acceptable in most situations. The interferer will be constrained to a short time interval and extending the interleaving and FEC coding beyond this time interval will significantly reduce the amount of bit errors caused by the interferer. If the energy concentrated signal is a TDMA signal the interleaving and coding will preferably extend over an entire frame length

In accordance with the invention the interference levels can be further reduced by spreading the spread energy signal unevenly in frequency depending on the interference to and from remote units using the shared spectrum for communicating in the other direction. This is illustrated in FIG. 5 where an evenly spread signal 501, an unevenly spread signal 503 and narrowband signals 505 are shown, the spread signals representing communication in one direction and the narrowband signals representing communication in the other direction. By concentrating the spread signal

energy towards the spectrum not used by narrowband signals, the interference to and from these is reduced

As an example spreading codes used for current CDMA systems are optimised for a flat frequency response as this gives optimum performance for a pure CDMA system. However, in the proposed system there can be much higher interference in some frequency bands than in others and it is therefore preferred to use non-flat spreading codes which concentrate the CDMA signal energy towards frequencies with minimum interference. For example, if the narrowband interferers are allocated towards the higher frequencies, a spreading code concentrating energy towards lower frequencies can be used (ref. FIG. 5). Any other distribution is equally applicable to the current invention, for example allocating narrowband carriers periodically or towards the lower or middle part of the frequency bands in order to optimise the system for the given spectral shaping of the spread signal. The method can be used adaptively dependent on the number and level of narrowband interferers. The shaping of the spreading can either be obtained by changing the spreading code or by modifying the pulseshape of the spreading signal. If the spreading is done using frequency hopping, the effect can be obtained simply by increasing the concentration of hops to frequency bands with less interference.

Another aspect of the invention concerns the reduction of interference between remote units in the described communication system by allocation of channels in the shared portion of the frequency spectrum to remote units geographically separated. An example of the principle of allocation is illustrated in FIG. 6 which shows one central station 601, a plurality of remote units 603 and three areas 605, 607 and 609 dividing the remote units into groups depending on their distance to the central station 601. According to the invention calls can be set up using the dedicated portions of the frequency spectrum, and as desired calls can be allocated channels in the shared spectrum in such a way, that they use the shared spectrum for communication in one direction and the appropriate dedicated spectrum for communication in the other direction. The principle of allocation of the shared spectrum is that it is used in one direction by the remote units closest to the central station and in the reverse direction by the remote units furthest from the central station. With reference to the figure, remote units

603 in area 605 will thus be allocated for example downlink channels in the shared spectrum and uplink channels in the dedicated uplink frequency spectrum whereas the remote units in area 609 will be allocated uplink channels in the shared spectrum and downlink channels in the dedicated spectrum. The basic principle is thus to allocate channels so that remote units uplinking in the shared spectrum are kept as far as possible from the remote units downlinking. This maximises the minimum coupling loss between remote units sharing spectrum and thereby minimises interference.

FIG. 7 is an illustration of a process flowchart 700 of a preferred embodiment of this method. The method is preferably implemented in the controller of the central station 601 but may be implemented in the remote units 603 or distributed throughout the system.

The process starts in step 701 where the distance between the central station 601 and the remote unit 603 is estimated. The further the remote unit 603 is from the central station 601 the higher the propagation loss and the preferred method of estimating the distance is therefore from measurement of the received signal strength and knowledge of the transmitted power level, or simply from knowledge of the transmitted power level for a given transmission quality. However, other alternatives include measurement of transmission delay, such as timing advance for GSM systems, or using location information, such as information from Global Positioning System receivers included in the remote units as is envisaged for some future communication systems.

Step 703 follows from step 701 and consists in allocating radio channels in the shared portion of the frequency spectrum to the furthest of the remote units 603. The allocation is such that the remote units 603 are allocated channels in one direction in the appropriate non-shared spectrum and channels in the second direction in the shared spectrum.

Step 705 which follows from step 701 and may be independent of step 703 allocates channels to the closest remote units 603. The allocation is reciprocal to the allocation of channels to the furthest remote units in step 703. The remote units are thus allocated channels in the appropriate non-shared spectrum for communication in the direction in which the furthest

remote units 603 use the shared spectrum. The closest remote units 603 are furthermore allocated channels in the reverse direction in the shared frequency spectrum but utilising a different transmission scheme in accordance with the invention.

The invention thus provides a communication system or method of communication based on using different transmission schemes in the uplink and downlink direction. The use of two different transmission schemes allows for the uplink and downlink signals to have a large disparity and this enables the cross interference between these signals to be minimised. As a consequence the sharing of a portion of frequency spectrum for simultaneously communicating in both directions is substantially facilitated.

Claims

1. A communication system (100) including a first central station (101), a plurality of remote units (103), and a frequency spectrum for providing communication services to the plurality of remote units, the communication system comprising:

means for transmitting between the first central station(101) and a first remote unit (103) in a first portion (203) of the frequency spectrum in a first direction using a first transmission scheme;

and the communication system being characterised by comprising:

means for transmitting simultaneously between the first central station (101) and a second remote unit in the first portion (203) of the frequency spectrum in a second direction using a second transmission scheme.

2. A communication system as claimed in Claim 1 characterised by said first transmission scheme using spread energy signals and said second transmission scheme using concentrated energy signals.

3. A communication system as claimed in Claim 1 characterised by said first transmission scheme using a substantially time continuous signal with low power variation, and said second transmission scheme using a time discontinuous signal with high peak power during transmission bursts.

4. A communication system as claimed in Claim 1 characterised by the use of a Time Division Multiple Access (TDMA) scheme in said first direction and Code Division Multiple Access (CDMA) in said second direction.

5. A communication system as claimed in Claim 1 characterised by the use of an Orthogonal Frequency Division Multiple Access (OFDMA) scheme in said first direction and Code Division Multiple Access (CDMA) in said second direction.

6. A communication system as claimed in Claim 1 characterised by a second portion (201) of said frequency spectrum being dedicated to communication in said first direction and a third portion (205) of said

frequency spectrum being dedicated to communication in said second direction.

7. A communication system as claimed in claim 6 further including a controller (305) for allocating users characterised by comprising:

a) means for estimating a distance from said first central station to said plurality of remote units (103);

b) means for allocating channels to the furthest of said plurality of remote units (103) in said first portion (203) of the frequency spectrum for communicating in said first direction and in said third portion (205) of the frequency spectrum for communicating in said second direction; and

c) means for allocating channels to the closest of said plurality of remote units (103) in said first portion (203) of the frequency spectrum for communication in said second direction and in said second portion (201) of said frequency spectrum for communicating in said first direction.

8. A communication system as claimed in Claim 1 characterised by said first transmission scheme using broadband signals (401) with low spectral energy density and said second transmission scheme using narrowband signals (403) with high spectral energy density.

9. A communication system as claimed in Claim 8 characterised by said broadband signals (503) being unevenly spread signals.

10. A communication system as claimed in Claim 8 characterised by further comprising
means for selectively removing said narrowband signals (403) when receiving said broadband signals (401).

11. A method for communication in a communication system (100) including a first central station (101), a plurality of remote units (103), and a frequency spectrum for providing communication services to the plurality of remote units, the method comprising the steps of:

transmitting between the first central station (101) and a first remote unit (103) in a first portion (203) of the frequency spectrum in a first direction using a first transmission scheme;
and the method being characterised by comprising the step of:

transmitting simultaneously between the first central station (101) and a second remote unit in the first portion (203) of the frequency spectrum in a second direction using a second transmission scheme.

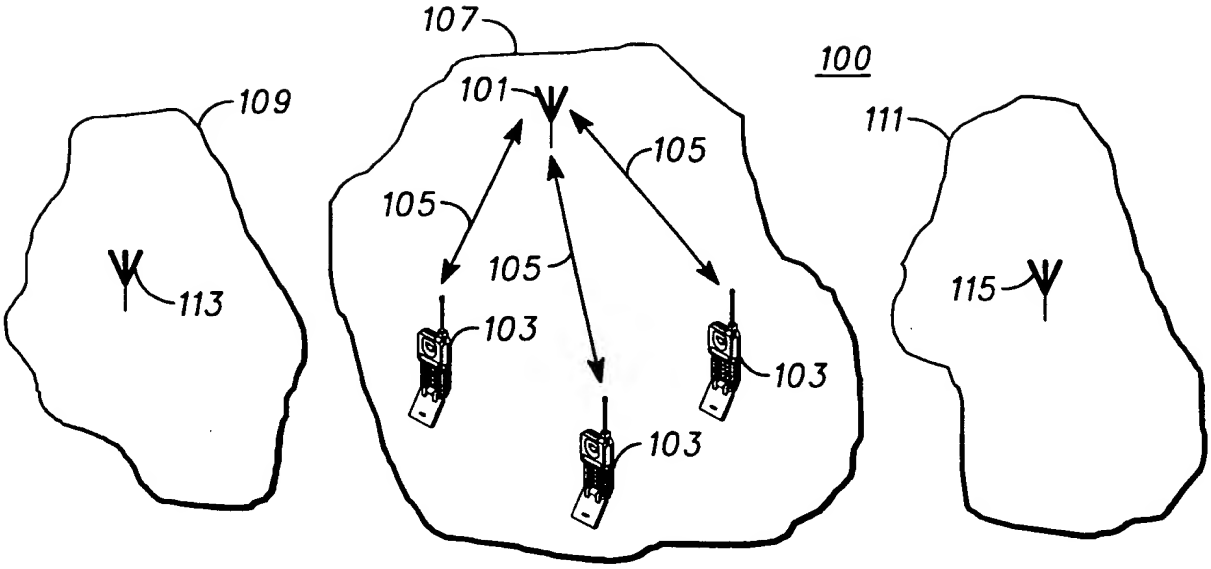

FIG.1

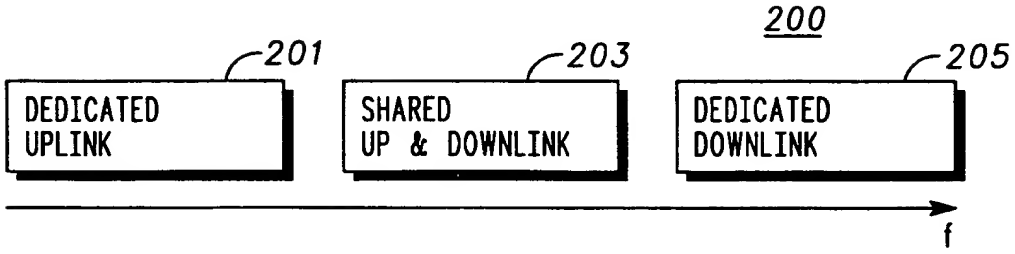

FIG.2

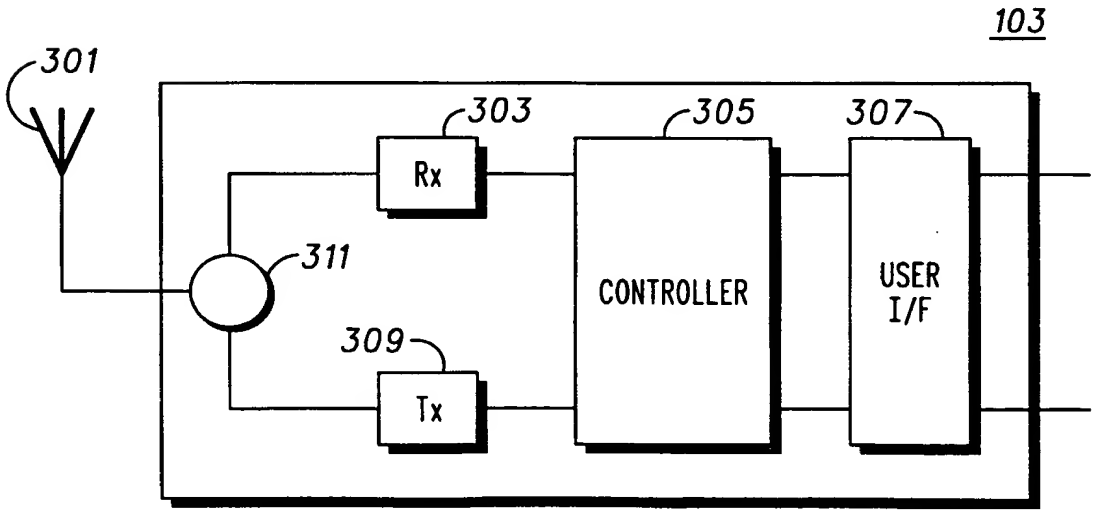

FIG.3

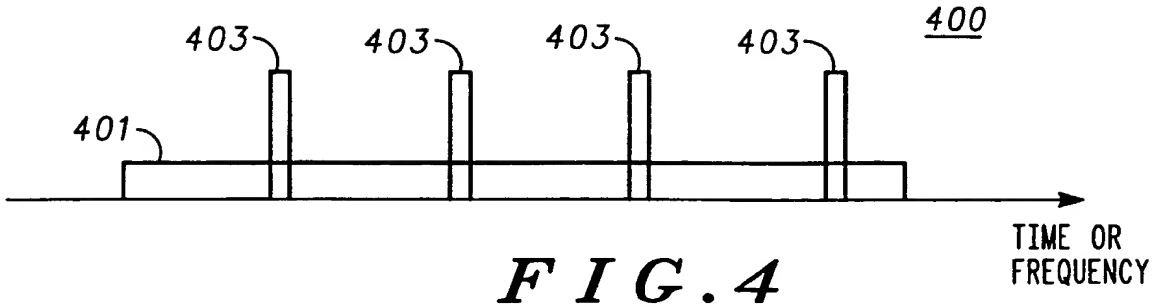

FIG. 4

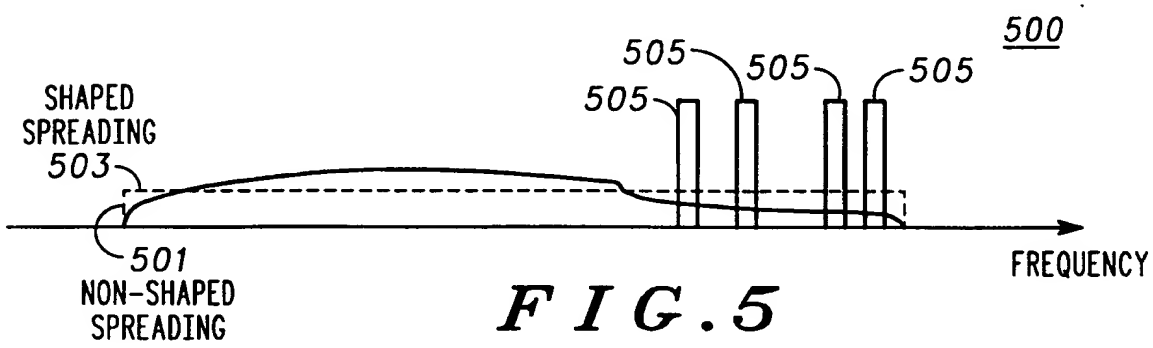

FIG. 5

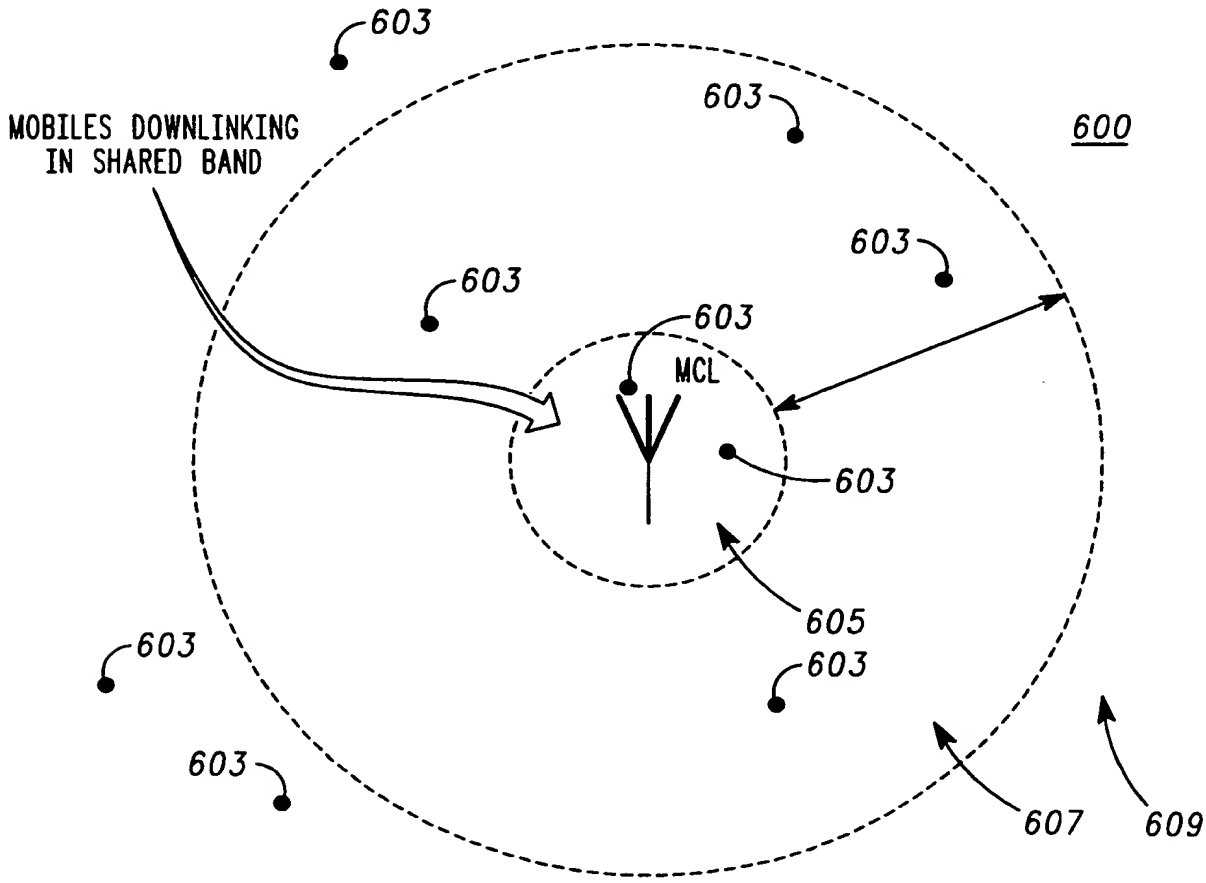

FIG. 6

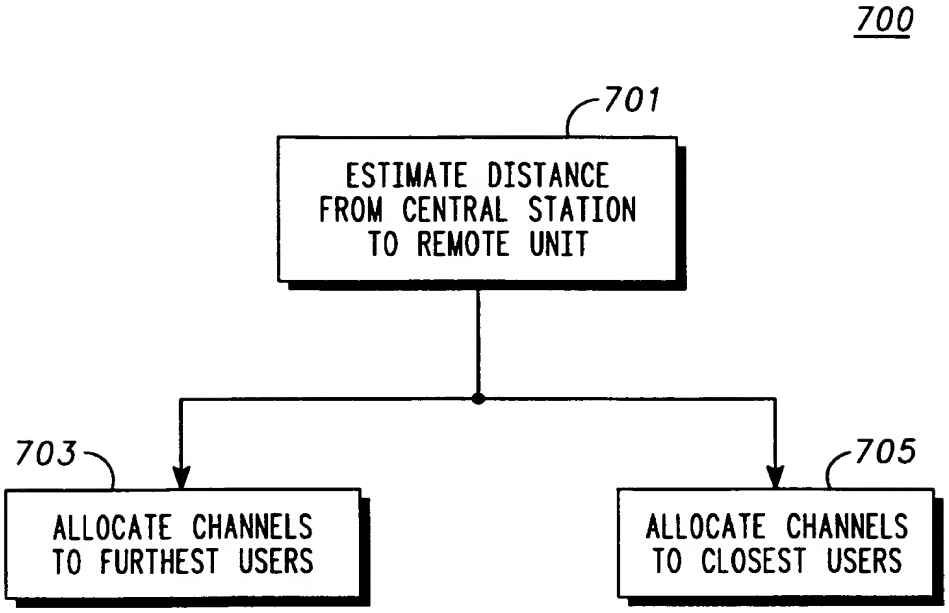
700
701
ESTIMATE DISTANCE FROM CENTRAL STATION TO REMOTE UNIT
703
ALLOCATE CHANNELS TO FURTHEST USERS
705
ALLOCATE CHANNELS TO CLOSEST USERS

FIG. 7

INTERNATIONAL SEARCH REPORT

Intern -- ial Application No
PCT/EP 98/06985

A. CLASSIFICATION OF SUBJECT MATTER
IPC 6 H04Q7/30 H04B7/26

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 6 H04Q H04B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	EP 0 662 775 A (ERICSSON GE MOBILE INC) 12 July 1995 see column 1, line 57 - column 2, line 2 see column 7, line 44 - line 46 see column 8, line 30 - line 39 see column 9, line 10 - line 23	1,4,11
X	US 5 566 168 A (DENT PAUL W) 15 October 1996 see column 7, line 33 - line 42	1,4,11
X	WO 95 24086 A (THIELECKE JORN ;GRANZOW WOLFGANG (DE); PHILIPS PATENTVERWALTUNG (D) 8 September 1995 see page 6, line 8 - line 10	1,5,11

-/--

[X] Further documents are listed in the continuation of box C.

[X] Patent family members are listed in annex.

° Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

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"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

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"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
24 February 1999	03/03/1999

Name and mailing address of the ISA	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax: (+31-70) 340-3016	Leouffre, M

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Form PCT/ISA/210 (second sheet) (July 1992)

INTERNATIONAL SEARCH REPORT

Intern ...ial Application No
PCT/EP 98/06985

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category °	Citation of document, with indication,where appropriate, of the relevant passages	Relevant to claim No.
E	WO 98 51111 A (KONINKL PHILIPS ELECTRONICS NV ;PHILIPS AB (SE)) 12 November 1998 see abstract; claims 4,5 ---	1,4,11
A	EP 0 600 713 A (NOKIA MOBILE PHONES LTD ;NOKIA TELECOMMUNICATIONS OY (FI)) 8 June 1994 see column 6, line 32 - line 42; figure 4A -----	1,4,11

Form PCT/ISA/210 (continuation of second sheet) (July 1992)

INTERNATIONAL SEARCH REPORT

Information on patent family members

Intern. -- al Application No
PCT/EP 98/06985

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
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		DE 69503072 T	10-12-1998
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PCT REQUEST

For receiving Office use only

PCT/EP 98/06985
International Application No.

21 10. 1998 21 OCT 1998
International Filing Date

EUROPEAN PATENT OFFICE
PCT INTERNATIONAL APPLICATION
Name of receiving Office and "PCT International Application"

Applicant's or agent's file reference
(if desired)(12 characters maximum) CE30382P/PCT

The undersigned requests that the present international application be processed according to the Patent Cooperation Treaty.

Box No. I TITLE OF INVENTION COMMUNICATION SYSTEM AND METHOD FOR COMMUNICATION

Box No. II APPLICANT

Name and address: *(Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country. The country of the address indicated in this Box is the applicant's State (that is, country) of residence if no State of residence is indicated below.)*

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☐ This person is also inventor.

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Facsimile No.

Teleprinter No.

State *(i.e. country)* of nationality: United Kingdom

State *(i.e. country)* of residence: United Kingdom

This person is applicant for the purposes of: ☒ all designated States ☐ all designated States except the United States of America ☐ the United States of America only ☐ the States indicated in the Supplemental Box

Box No. III FURTHER APPLICANTS AND/OR (FURTHER) INVENTORS

Name and address: *(Family name followed by given name; for a legal entity, full official designation. The address must include postal code and name of country. The country of the address indicated in this Box is the applicant's State (that is, country) of residence if no State of residence is indicated below.)*

JEPSEN, Rene
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This person is:

☐ applicant only
☒ applicant and inventor
☐ inventor only *(if this check-box is marked, do not fill in below.)*

State *(i.e. country)* of nationality: Denmark

State *(i.e. country)* of residence: Great Britain UK

This person is applicant for the purposes of: ☐ all designated States ☐ all designated States except the United States of America ☒ the United States of America only ☐ the States indicated in the Supplemental Box

☒ Further applicants and/or (further) inventors are indicated on a continuation sheet.

Box No. IV AGENT OR COMMON REPRESENTATIVE; OR ADDRESS FOR CORRESPONDENCE

The person identified below is hereby/has been appointed to act on behalf of the applicant(s) before the competent International Authorities as: ☒ agent ☐ common representative

Name and address: *(Family name followed by given name: for a legal entity, full official designation. The address must include postal code and name of country)*

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Midpoint, Alencon Link
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United Kingdom

Telephone No.
01256 790790

Facsimile No.
01256 811319

Teleprinter No.

☐ **Address for correspondence:** Mark this check-box where no agent or common representative is/has been appointed and the space above is used instead to indicate a special address to which correspondence should be sent.

See Notes to the request form

Continuation of Box No. [redacted] FURTHER APPLICANTS AND/OR (FURTHER) INVENTORS

If none of the following sub-boxes is used, this sheet is not to be included in the request.

Name and address: *(Family name followed by given name: for a legal entity, full official designation. The address must include postal code and name of country. The country of the address indicated in this Box is the applicant's State (that is, country) of residence if no State of residence is indicated below.)*

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United Kingdom

This person is:
- ☐ applicant only
- ☒ applicant and inventor
- ☐ inventor only *(if this check-box is marked, do not fill in below.)*

State *(i.e. country)* of nationality: ~~Great Britain~~ UK

State *(i.e. country)* of residence: ~~Great Britain~~ UK

This person is applicant for the purposes of: ☐ all designated States ☐ all designated States except the United States of America ☒ the United States of America only ☐ the States indicated in the Supplemental Box

Name and address: *(Family name followed by given name: for a legal entity, full official designation. The address must include postal code and name of country. The country of the address indicated in this Box is the applicant's State (that is, country) of residence if no State of residence is indicated below.)*

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Swindon, Wiltshire
SN5 5BJ, United Kingdom

This person is:
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- ☒ applicant and inventor
- ☐ inventor only *(if this check-box is marked, do not fill in below.)*

State *(i.e. country)* of nationality: ~~Great Britain~~ UK

State *(i.e. country)* of residence: ~~Great Britain~~ UK

This person is applicant for the purposes of: ☐ all designated States ☐ all designated States except the United States of America ☒ the United States of America only ☐ the States indicated in the Supplemental Box

Name and address: *(Family name followed by given name: for a legal entity, full official designation. The address must include postal code and name of country. The country of the address indicated in this Box is the applicant's State (that is, country) of residence if no State of residence is indicated below.)*

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United Kingdom

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- ☒ applicant and inventor
- ☐ inventor only *(if this check-box is marked, do not fill in below.)*

State *(i.e. country)* of nationality: ~~Great Britain~~ UK

State *(i.e. country)* of residence: ~~Great Britain~~ UK

This person is applicant for the purposes of: ☐ all designated States ☐ all designated States except the United States of America ☒ the United States of America only ☐ the States indicated in the Supplemental Box

Name and address: *(Family name followed by given name: for a legal entity, full official designation. The address must include postal code and name of country. The country of the address indicated in this Box is the applicant's State (that is, country) of residence if no State of residence is indicated below.)*

This person is:
- ☐ applicant only
- ☐ applicant and inventor
- ☐ inventor only *(if this check-box is marked, do not fill in below.)*

State *(i.e. country)* of nationality:

State *(i.e. country)* of residence:

This person is applicant for the purposes of: ☐ all designated States ☐ all designated States except the United States of America ☐ the United States of America only ☐ the States indicated in the Supplemental Box

☐ Further applicants and/or (further) inventors are indicated on a continuation sheet.

Box No. V DESIGNATION OF STATES

The following designations are hereby made under Rule 4.9 *(mark the applicable check boxes; at least one must be marked)*:

Regional Patent

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- ☐ EA **Eurasian Patent:** AM Armenia, AZ Azerbaijan, BY Belarus, KG Kyrgyzstan, KZ Kazakstan, MD Republic of Moldova, RU Russian Federation, TJ Tajikistan, TM Turkmenistan, and any other State which is a Contracting State of the Eurasian Patent convention and of the PCT.
- ☒ EP **European Patent:** AT Austria, BE Belgium, CH and LI Switzerland and Liechtenstein, CY Cyprus, DE Germany, DK Denmark, ES Spain, FI Finland, FR France, GB United Kingdom, GR Greece, IE Ireland, IT Italy, LU Luxembourg, MC Monaco, NL Netherlands, PT Portugal, SE Sweden, and any other State which is a Contracting State of the European Patent Convention and of the PCT
- ☐ OA **OAPI Patent:** BF Burkina Faso, BJ Benin, CF Central African Republic, CG Congo, CI Côte d'Ivoire, CM Cameroon, GA Gabon, GN Guinea, ML Mali, MR Mauritania, NE Niger, SN Senegal, TD Chad, TG Togo, and any other State which is a member State of OAPI and a Contracting State of the PCT *(if other kind of protection or treatment desired, specify on dotted line)*.....

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☐	AT	Austria	☐	LU	Luxembourg
☐	AU	Australia	☐	LV	Latvia
☐	AZ	Azerbaijan	☐	MD	Republic of Moldova
☐	BA	Bosnia and Herzegovina	☐	MG	Madagascar
☐	BB	Barbados	☐	MK	The former Yugoslav Republic of Macedonia
☐	BG	Bulgaria	☐	MN	Mongolia
☐	BR	Brazil	☐	MW	Malawi
☐	BY	Belarus	☐	MX	Mexico
☐	CA	Canada	☐	NO	Norway
☐	CH and LI	Switzerland and Liechtenstein	☐	NZ	New Zealand
☒	CN	China	☐	PL	Poland
☐	CU	Cuba	☐	PT	Portugal
☐	CZ	Czech Republic	☐	RO	Romania
☐	DE	Germany	☒	RU	Russian Federation
☐	DK	Denmark	☐	SD	Sudan
☐	EE	Estonia	☐	SE	Sweden
☐	ES	Spain	☐	SG	Singapore
☐	FI	Finland	☐	SI	Slovenia
☐	GB	United Kingdom	☐	SL	Sierra Leone
☐	GE	Georgia	☐	SK	Slovakia
☐	GH	Ghana	☐	TJ	Tajikistan
☐	GM	Gambia	☐	TM	Turkmenistan
☐	GW	Guinea-Bissau	☐	TR	Turkey
☐	HR	Croatia	☐	TT	Trinidad and Tobago
☐	HU	Hungary	☐	UA	Ukraine
☐	ID	Indonesia	☐	UG	Uganda
☒	IL	Israel	☒	US	United States of America
☐	IS	Iceland	☐	UZ	Uzbekistan
☐	JP	Japan	☐	VN	Viet Nam
☐	KE	Kenya	☐	YU	Yugoslavia
☐	KG	Kyrgyzstan	☐	ZW	Zimbabwe
☐	KP	Democratic People's Republic of Korea			
☐	KR	Republic of Korea			
☐	KZ	Kazakhstan			
☐	LC	Saint Lucia			
☐	LK	Sri Lanka			
☐	LR	Liberia			

Check-boxes reserved for designating States (for the purposes of a national patent) which have become party to the PCT after issuance of this sheet:

☐ .....

☐ .....

☐ .....

(Page 3 continued to next p

Precautionary Designation Statement: In addition to the designations made above, the applicant makes under Rule 4.9(b) all other designations which would be permitted under the PCT except any designation(s) indicated in the Supplemental Box as being excluded from the scope of this statement.. The applicant declares that those additional designations are subject to confirmation and that any designation which is not confirmed before the expiration of 15 months from the priority date is to be regarded as withdrawn by the applicant at the expiration of that time limit.. *(Confirmation of a designation consists of the filing of a notice specifying that designation and the payment of the designation and confirmation fees. Confirmation must reach the receiving Office within the 15-month time limit.)*

Supplemental Box *If the Supplemental Box is not used, this sheet should not be included in the request.*

1. If, in any of the Boxes, the space is insufficient to furnish all the information: in such case, write "Continuation of Box No. ..." [indicate the number of the Box] and furnish the information in the same manner as required according to the captions of the Box in which the space was insufficient, in particular:

(i) If more than two persons are involved as applicants and/or inventors and no "continuation sheet" is available: in such case, write "Continuation of Box No. III" and indicate for each additional person the same type of information as required in Box No. III. The country of the address indicated in this Box is the applicant's State (that is, country) of residence if no State of residence is indicated below;

(ii) If, in Box No. II or in any of the sub-boxes of Box No. III, the indication "the States indicated in the Supplemental Box" is checked: in such case, write "Continuation of Box No. II" or "Continuation of Box No. III" or "Continuation of Boxes No. II and No. III" (as the case may be), indicate the name of the applicant(s) involved and, next to (each) such name, the State(s) (and/or, where applicable, ARIPO, Eurasian, European or OAPI patent) for the purposes of which the named person is applicant;

(iii) If, in Box No. II or in any of the sub-boxes of Box No. III, the inventor or the inventor/applicant is not inventor for the purposes of all designated States or for the purposes of all designated States of America: in such case, write "Continuation of Box No. II" or "Continuation of Box No. III" or Continuation of Boxes No. II and No. III" (as the case may be), indicate the name of the inventor(s) and, next to (each) such name, the State(s) (and/or, where applicable, ARIPO, Eurasian, European or OAPI patent) for the purposes of which the named person is inventor;

(iv) If, in addition to the agent(s) indicated in Box No. IV, there are further agents: in such case, write "Continuation of Box No. IV" and indicate for each further agent the same type of information as required in Box No. IV;

(v) If, in Box No. V, the name of any State (or OAPI) is accompanied by the indication "patent of addition," or "certificate of addition," or if, in Box No. V, the name of the United States of America is accompanied by an indication "continuation" or "Continuation-in-part": in such case, write "Continuation of Box No. V" and the name of each State involved (or OAPI), and after the name of each such State (or OAPI), the number of the parent title or parent application and the date of grant of the parent title or filing of the parent application;

(vi) If, in Box No. VI, there are more that three earlier applications whose priority is claimed: in such case, write "Continuation of Box No. VI" and indicate for each additional earlier application the same type of information as required in Box No. VI.

(vii) If, in Box No. VI, the earlier application is an ARIPO application: in such case, write "Continuation of Box No VI", specify the number of the item corresponding to that earlier application and indicate at least one country party to the Paris Convention for the Protection of Industrial Property for which that earlier application was filed.

2. If, with regard to the precautionary designation statement contained in Box No. V, the applicant wishes to exclude any State(s) from the scope of that statement: in such case, write "Designation(s) excluded from precautionary designation statement" and indicate the name or two-letter code of each State so excluded

3. If the applicant claims, in respect of any designated Office, the benefits of provisions of the national law concerning non-prejudicial disclosures or exceptions to lack of novelty: in such case, write "Statement concerning non-prejudicial disclosures or exceptions to lack of novelty" and furnish that statement below

Continuation of Box No. IV

IBBOTSON, Harry
GIBSON, Sarah
MORGAN, Marc
POTTS, Susan
WILLIAMSON, Simeon

All above attorneys/agents are members of Motorola, Inc., Intellectual Property Department and have the same address, telephone number and telegraphic address as indicated in Box IV.

Box No. VI PRIORITY CLAIM Further priority claims are indicated in the Supplemental Box ☐

Priority of the following earlier application(s) is claimed:		Office where earlier application filed	
Filing Date of earlier application *(day/month/year)*	Number of earlier application	National application = country; regional application = regional Office	International application = receiving Office
item (1) 27 October 1997 (27.10.97)	9722511.4	United Kingdom	
item (2)			
item (3)			

☐ The receiving Office is requested to prepare and transmit to the International Bureau a certified copy of the earlier application(s) *(only if the earlier application was filed with the Office which for the purposes of the present international application is the receiving Office)* identified above as item(s): _____

* *Where the earlier application is an ARIPO application, it is mandatory to indicate in the Supplemental Box at least one country party to the Paris Convention for the Protection of Industrial Property for which that earlier application was filed (Rule 4.10(b)(ii). See Supplemental Box.*

Box No. VII INTERNATIONAL SEARCHING AUTHORITY

Choice of International Searching Authority (ISA) *(if two or more International Searching Authorities are competent to carry out the international search, indicate the Authority chosen; the two-letter code may be used):* ISA/EP

Request to use results of earlier search; reference to that search *(if an earlier search has been carried out by or requested from the International Searching Authority):*

Date *(day/month/year)* Number: Country (or regional office):

Box No. VIII CHECK LIST; LANGUAGE OF FILING

This international application contains the following number of sheets:

1. request	5	sheets
2. description (excluding sequence listing part)	10	sheets
3. claims	3	sheets
4. abstract	1	sheets
5. drawings	3	sheets
6. sequence listing part of description	0	sheets
Total	22	sheets

This international application is accompanied by the item(s) marked below:

1. ☒ fee calculation sheet
2. ☐ separate signed power of attorney
3. ☒ copy of general power of attorney
4. ☐ statement explaining lack of signature
5. ☐ priority document(s) identified in Box No. VI as item(s):
6. ☐ translation of international application into (language): _____
7. ☐ separate indications concerning deposited microorgs./biological mat.
8. ☐ nucleotide and/or amino acid sequence listing in computer readable form
9. ☐ other *(specify)*: copy, U.S. assignment

Figure No. 1 of the drawings (if any) should accompany the abstract when it is published.

Language of filing of the international application:

Box No. IX SIGNATURE OF APPLICANT OR AGENT

Next to each signature, indicate the name of the person signing and the capacity in which the person signs (if such capacity is not obvious from reading the request).

BY

For Receiving Office use only

1. Date of actual receipt of the purported international application: 21 10. 1998 — 21 OCT 1998
3. Corrected date of actual receipt due to later but timely received papers or drawings completing the purported international application:
4. Date of timely receipt of the required corrections under PCT Article 11(2):
5. International Searching Authority specified by the applicant: ISA/
6. ☐ Transmittal of search copy delayed until search fee is paid

2. Drawings:
   - ☒ received:
   - ☐ not received:

For International Bureau use only

Date of receipt of the record copy by the International Bureau: